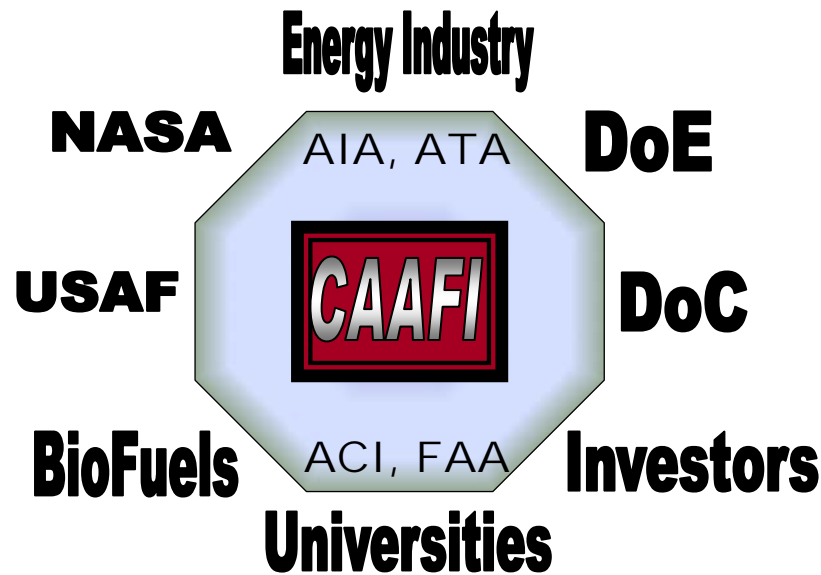


# Alternative Fuels in Commercial Aviation

## The Need, the Approach, Progress



Richard L. Altman, Executive Director  
Commercial Aviation Alternative Fuels Initiative  
Friday, March 16, 2007

# Alternative Fuels in Commercial Aviation

## *Need Defined, Approach Established, Progress Made*

- **Commercial Aviation Need Defined**
  - Multiple Facets
  - Supply stability a Key ingredient
- **Commercial Aviation Alternative Fuels Initiative (CAAFI) Process**
  - Who are We?
  - What is our Mission?
  - How are we Structured to Execute?
  - CAAFI Accomplishments
- **Alternative Fuels Progress**
  - Fuels Approval process / near term options
  - Environmental Opportunity Defined
  - CAAFI Roadmap communications/planning tool
  - Far term renewables R&D

# Alternative Fuels

## Commercial Need Drivers

Price



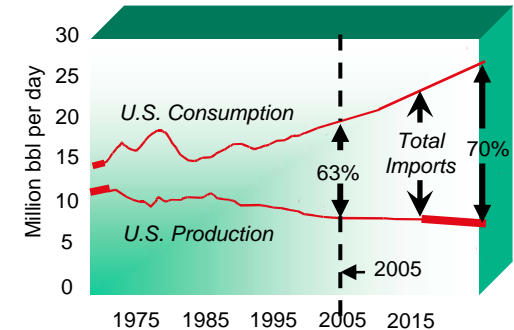
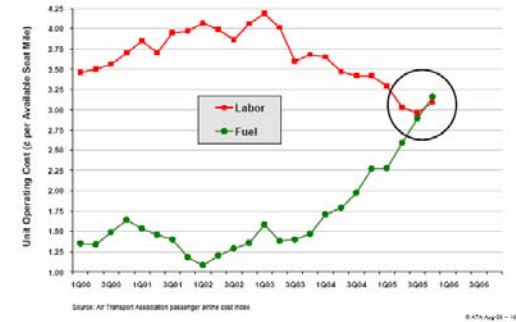
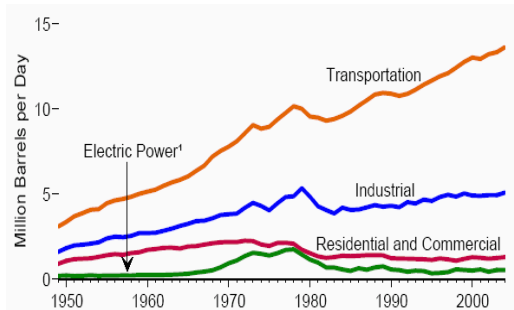
Availability



Energy  
Independence



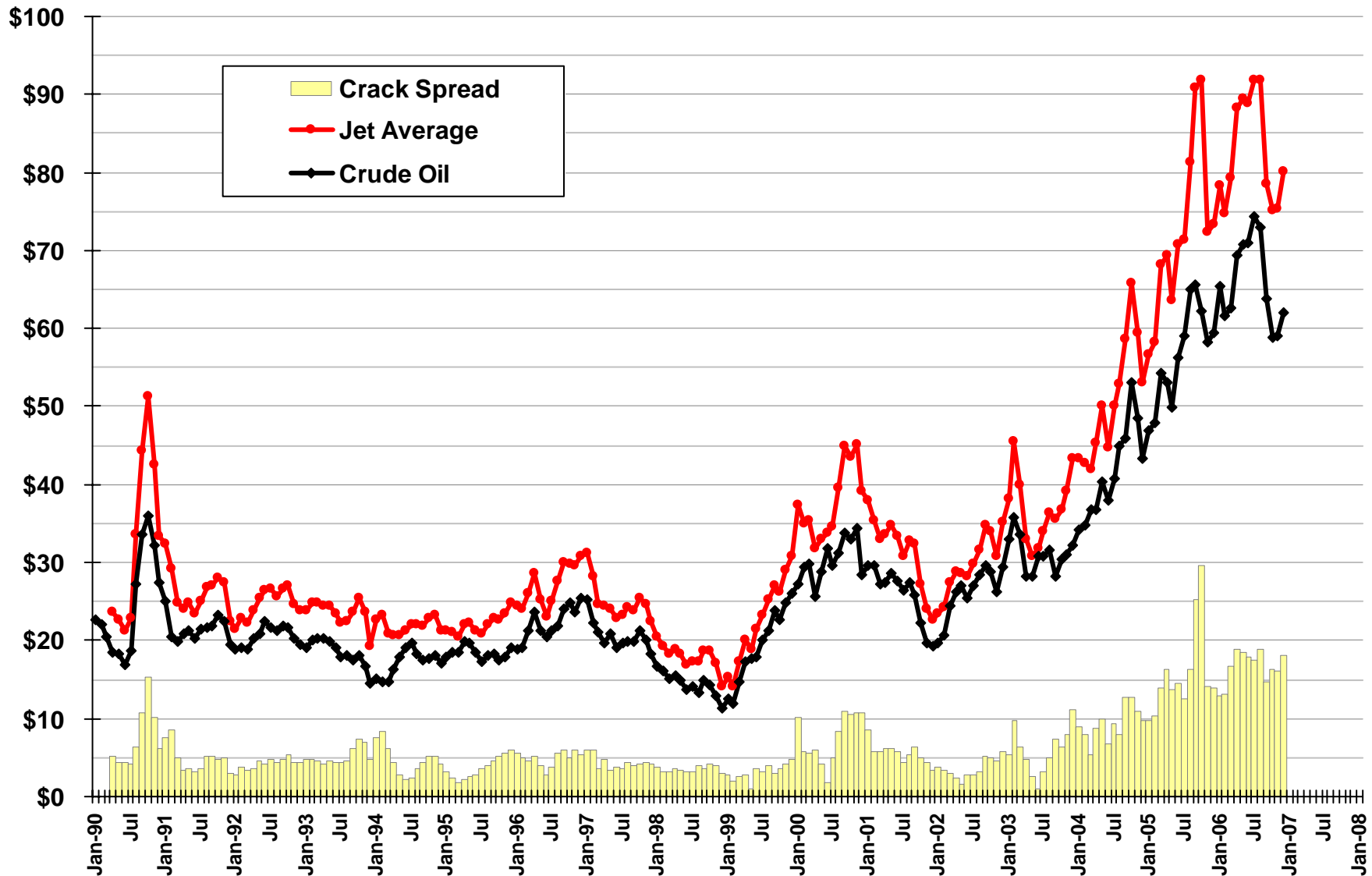
Environmental  
Issues



..... And must meet specification for safety

# Commercial Fuel Price Up -----

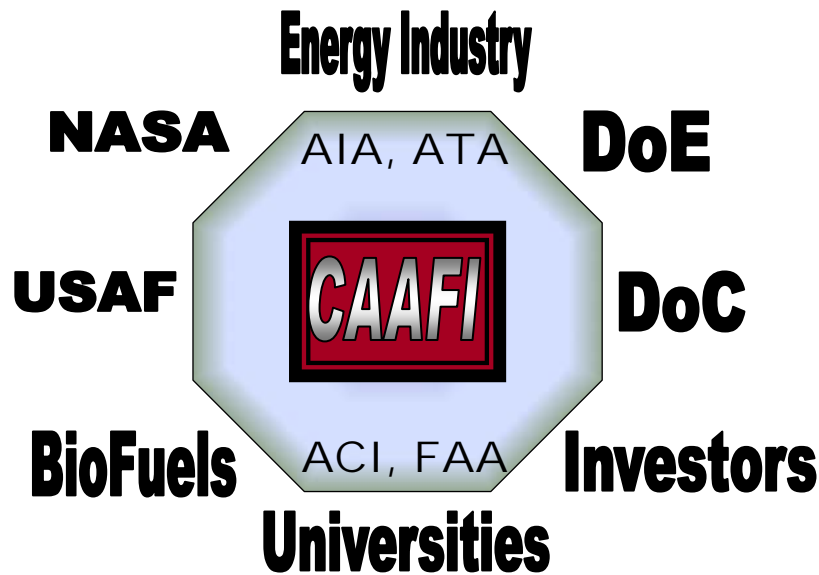
## *Supply Stability Down*



Sources U.S Energy Information Administration and the Air Transport Association of America

# Commercial Aviation Alternative Fuels Initiative

## *Aligning Supply Chain to Address Aviation Needs*



.....to work together with DoD/DOE to pursue alternative fuels for the purpose of:

- Securing a stable fuel supply
- Furthering research and analysis
- Quantifying the ability to reduce environmental impacts
- Improving aircraft operations

# CAAFI Process Accomplishments

*Since 10/24, 25/2006 Inception*

- Formed four panels and adopted missions, and objectives for each (R&D, Certification/Qualification, Environmental, Economics/Business/ Policy)
- Executed Workshop with 80 sponsors/stakeholder specialists producing roadmaps communicating plans cross sponsor/stakeholder functions
- Motivated/focused funding for three projects now in formation/ complementing USAF thrusts
  - Rand – commercial economics
  - PARTNER (COE) – environmental benefit/cost
  - ACRP - airport benefits analysis

# Alternative Aviation Fuels

## *Options to Be Considered*

### •Near term (0-5 years):

- Fischer-Tropsch fuel from coal\*

### •Mid term (5-15 years):

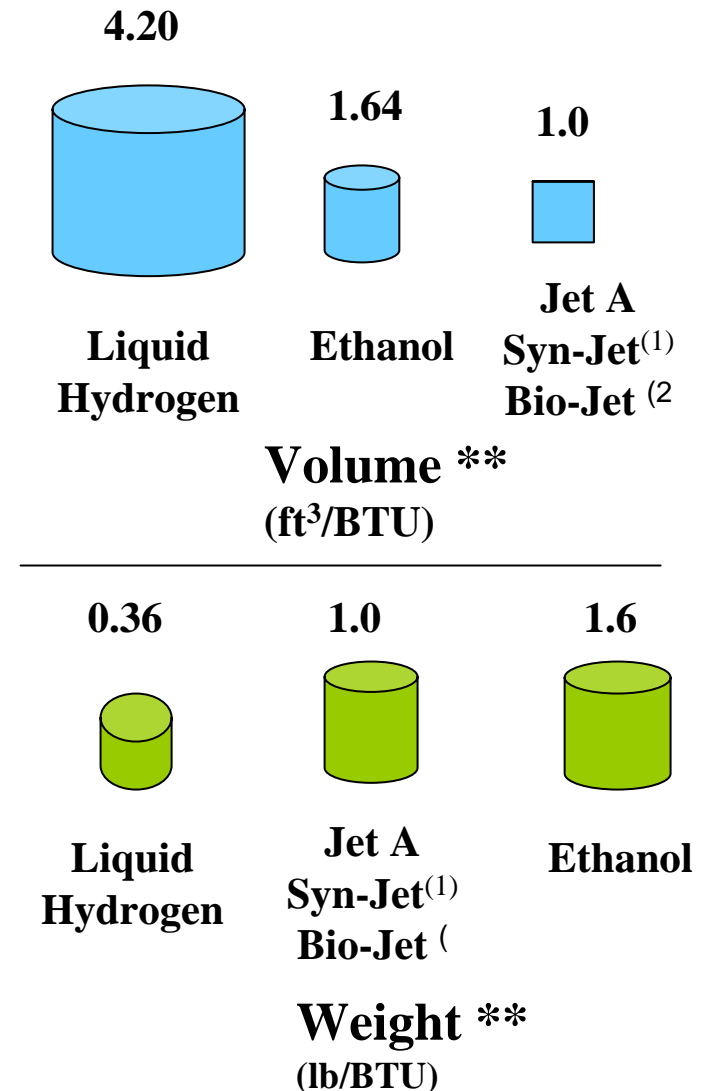
- Oil shale\*
- Other HC: LNG, ethanol blends,\* biodiesel\*
- Hydrogen for fuel cells in APUs

### •Far term (15+ years):

- Biomass: black liquor fuels\*
- Hydrogen fuel for turbine engines

\* Assessment by the US Air Force Scientific Advisory Board

\*\* Analysis Dave Daggett – The Boeing Company,  
1.0 = Drop in for current aircraft



# Fischer Tropsch Derived Aviation Fuels

## *Development and Qualification Status*

### Products / Technology

- 100% SASOL FT  
(substitute for Jet A (CTL))

- 50% syntroleum FT (GTL)  
(substitute for JP8)

- Iso Parifinic Kerosene  
blanket approvals

- DARPA (other) renewable  
fuel research

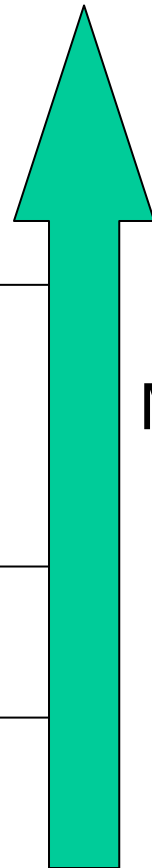
### Status

- Single source approval
- All tests complete
- OEM approvals  
1<sup>st</sup> quarter 2007

- Second data source
- Final tests funded
- Results targeted by mid-  
year 2007

- 2008 target 50/50 F/T  
blend, 2009 100% F/T

- Virgin/other initiatives
- Awards granted 4Q 2006



Maturity  
Level



# SASOL Fully Synthetic

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## *Testing Complete to ASTM Protocols*

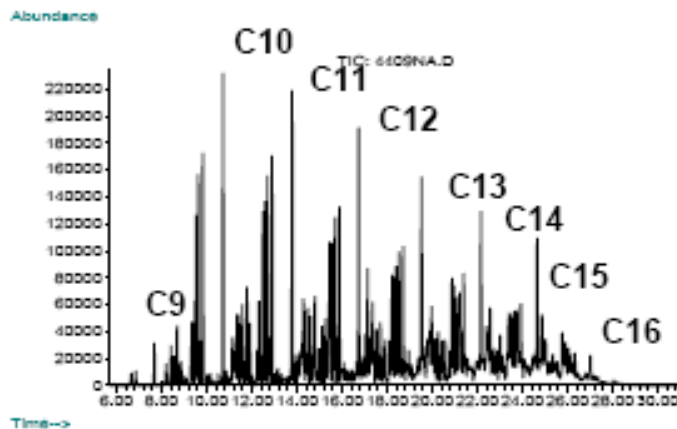
*Set by Commercial OEM's to Represent entire fleet*

- JT9D Engine Endurance Test (3/06)
  - South African Airlines/P&W, GE and Rolls
  - 500 cycles, 153 hours
- APU Fuel Atomizer Cold Spray – Honeywell (6/06)
  - No negative effect on APU cold starting
- Ignition Test – Rolls Royce (9/06)
  - Altitude relight, cold start meet criteria
- Emissions Test – Pratt & Whitney - (01/07)
  - Completed

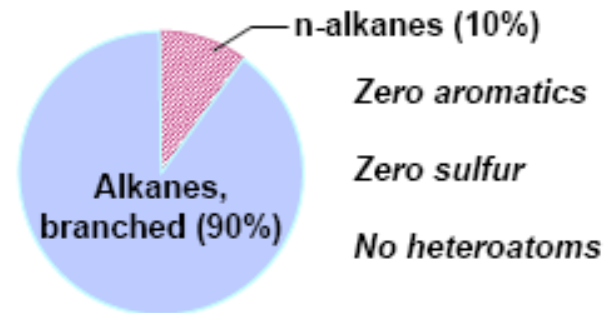
# Aviation Fuel Alternatives / Environment

## *FT Fuels Burn Cleanly.....but*

- Less Pollutant Emissions
  - 1.6% less CO<sub>2</sub>
  - 50% to 90% less particulate matter (PM)
  - 100% reduction in Sox
  - ~1% less fuel burn (increased gravimetric energy density)



Hydrocarbon types in Syntroleum S-5

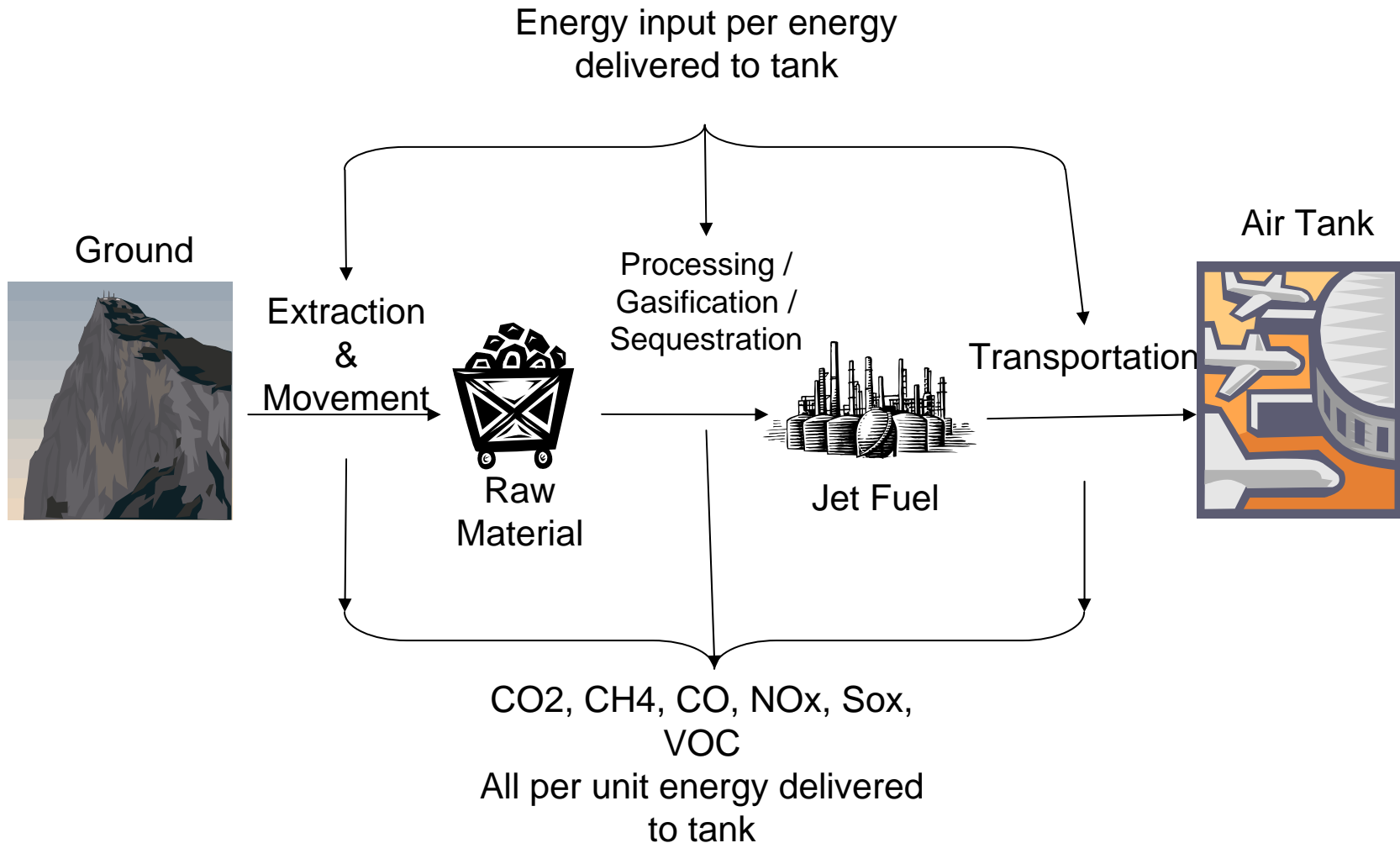


**Highly Paraffinic Fuel – normal and isoparaffins**

Petroleum derived fuels are rich in aromatics, cycloparaffins, and heteroatoms

# Alternative Fuels Environmental Analysis

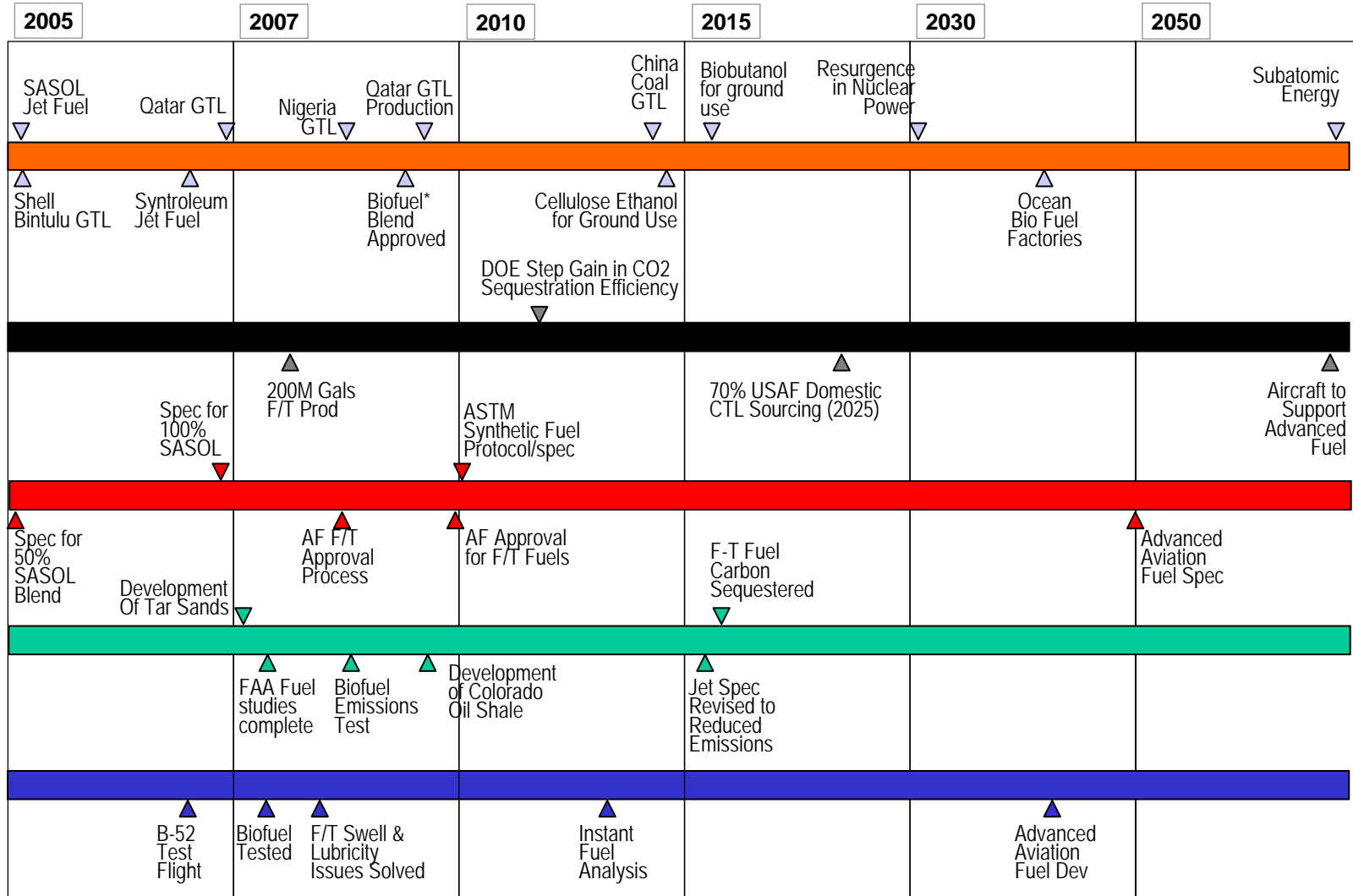
## *....Full Life Cycle Assessment In Process*



# CAAFI Alternative Fuels Roadmap

## Level 2 – Aggregates Team Process / Products

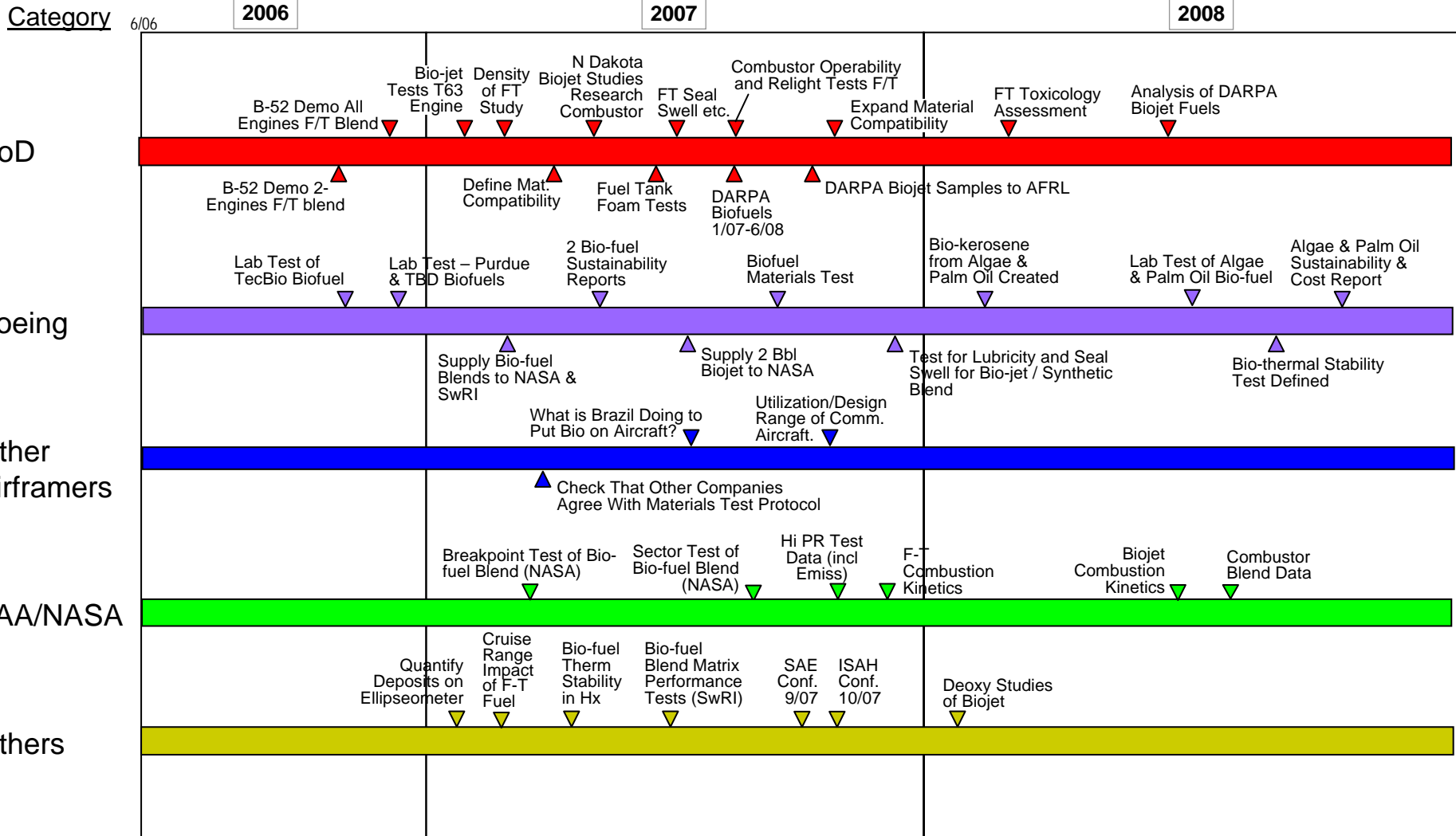
### Category



Status as of October 19, 2006

# CAAFI Alternative Fuels Roadmap

## *R&D (Level 3 / Scenario 1, Near Term)\**



\* Status as of November 16, 2006, CAAFI R&D Team (sheet 1 of 2)

# Alternative Fuels in Commercial Aviation

## *Need Defined, Approach Established, Progress Made*

- **The Need** - Supply Stability for Operators

- **The Approach** - Unified Aviation Supply Chain via CAAFI process

- **Progress** - Near Term FT Qualification, Long Term Renewables, Always environmental gains

